Direct Measurements of Field-Dependent Ordering in a Low-Field Vortex Glass State

Frederick S. Wells[1], Alexey V. Pan[1], X. Renshaw Wang[2,3],
Igor A. Golovchanskiy[1,5,6], Sergey A. Fedoseev[1,4], Hans Hilgenkamp[2],
Anatoly Rozenfeld[4]

[1]Institute for Superconducting and Electronic Materials, University of Wollongong, Northfields Avenue, Wollongong, NSW 2522, Australia
[2]Faculty of Science and Technology and MESA+ Institute for Nanotechnology, University of Twente, P.O. Box 217, 7500 AE Enschede, The Netherlands
[3]Electrochemical Energy Laboratory, Massachusetts Institute of Technology, Cambridge, MA 02139, USA
[4]Center for Medical Radiation Physics, University of Wollongong, Northfields Avenue, Wollongong, NSW 2522, Australia
[5]Laboratory of Topological Quantum Phenomena in Superconducting Systems, Moscow Institute of Physics and Technology, State University, 9 Institutskiy per., Dolgoprudny, Moscow Region, 141700, Russia
[6]Laboratory of Superconducting Metamaterials, National University of Science and Technology MISIS, 4 Leninsky prosp., Moscow, 119049, Russia

E-mail: pan@uow.edu.au

Abstract — The variation of topological defect density and hexatic order parameter were measured over a range of micro-Tesla fields in a two-dimensional superconducting vortex glass. This was achieved through scanning SQUID microscopy of the vortex distribution in $YBa_2Cu_3O_{7-\delta}$ thin films under fieldcooled conditions. It was discovered that while the defect density decreased for increasing magnetic fields, giving the impression of a more lattice-like vortex distribution, the hexatic order parameter also decreased, showing that the distribution was less orientationally ordered.

Keywords (Index Terms) — Flux pinning, superconducting thin films, yttrium barium copper oxide, scanning probe microscopy.